AD-A132 904 SURVIVABILITY REQUIREMENTS AND THEIR RELATIONSHIP TO COMMUNICATIONS SYSTEM DESIGN(U) DEFENSE COMMUNICATIONS ENGINEERING CENTER RESTON VA J A KRCEK APR 74 1/1

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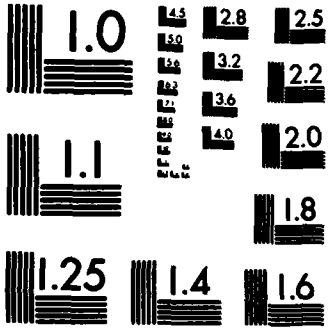

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TN 12-74

DEFENSE COMMUNICATIONS ENGINEERING CENTER

TECHNICAL NOTE NO. 12-74

SURVIVABILITY REQUIREMENTS AND THEIR RELATIONSHIP TO COMMUNICATIONS SYSTEM DESIGN (U)

APRIL 1974

[redacted]

UNCLASSIFIED

REPORT DOCUMENTATION PAGE

TN 12-74	
4. TITLE (and Subtitle) SURVIVABILITY REQUIREMENTS AND THEIR RELATIONSHIP TO COMMUNICATIONS SYSTEM DESIGN (U)	5. TYPE OF REPORT & PERIOD COVERED Technical Note 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J.A. Kreek	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Defense Communications Engineering Center Survivability Office 1860 Wiehle Ave., Reston, Va. 22090	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS N/A
11. CONTROLLING OFFICE NAME AND ADDRESS (Same as 9)	12. REPORT DATE April 1974 13. NUMBER OF PAGES 34
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) N/A	15. SECURITY CLASS. (of this report) [redacted] 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE [redacted]

16. DISTRIBUTION STATEMENT (of this Report)

None

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

N/A

18. SUPPLEMENTARY NOTES

Review relevance 5 years from submission date.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Survivability Requirements
Communications System Design
Collateral Damage Vulnerability
Command, Control & Communications
Defense Communications Agency)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report summarizes OSD, JCS, and DCA survivability requirements related to DCA systems, and relates these requirements to the system design of these communications systems.

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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APRIL 1974

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FOREWORD

The Defense Communications Engineering Center Technical Notes (TN's) are published to inform interested members of the defense community regarding technical activities of the Center, completed and in progress. They are intended to stimulate thinking, encourage information exchange, and provide guidance for related planning and research.

Comments or technical inquiries concerning this document are welcome, and should be directed to:

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I. INTRODUCTION

(U) Survivability of DCA command, control, and communications C^3 systems, as distinct from reliability of these systems, deals with loss of facilities or their impairment due to enemy action.

(U) The enemy action which leads to loss or impairment of the C^3 system capability can be direct, due to an enemy targeting of one or more of the facilities that make up the system, or it may be inadvertent, resulting from collateral effects from an attack against targets near to the C^3 facilities.

II. BACKGROUND

(U) For analytical purposes it is convenient to view survivability from the standpoint of collateral damage vulnerability separate from the vulnerability to direct attack. This is the case because it has been found desirable to apply corrective measures with respect to collateral effects without necessarily correcting a vulnerability to direct attack. JCS and OSD requirement documents are making increasing use of this cateogrization of survivability.

III. DISCUSSION

(U) Appendix A summarizes the statements of survivability requirements for DCA systems contained in OSD, JCS, and DCA documents.

(U) The statements of survivability requirements for DCA systems are of five categories, as follows:

a. Requirements for design of C^3 systems and subsystems to maintain a quantified capability level when subjected to collateral damage plus specific levels of direct targeting.

b. Requirements for the design and location of facilities to be invulnerable to physical damage from enemy attacks against other targets (i.e., collateral physical damage).

c. Requirements for design of equipments, subsystems facilities, circuits, and networks to be invulnerable to EMP from ABM detonations and enemy high altitude nuclear detonations (i.e., collateral EMP damage).

[redacted]

[redacted]

d. Requirements for design of circuit and network survivability to be commensurate with survivability of the commands served. This involves both collateral effects and effects due to targeting of C^3 facilities.

e. Requirements for systems to be made survivable but the degree, objectives, or investment for survivability is not bounded.

(U) Table 1 shows the source and applicability of these categories of survivability requirements.

IV. CONCLUSIONS

[redacted] Where the requirements for survivability are quantified with respect to the maximum threat and the concommitant system capability (category a. above), as for MEECN, the system engineer has a basis for designing to a given level of survivability for the given enemy threat. A remaining uncertainty in the process is a decision on how much additional investment should be advocated to meet the requirements. To provide a basis for this decision the designer should develop alternatives of design which range from a minimum cost for a low survivability design to the full survivability design regardless of cost. These alternatives provide management with a basis for a decision on how much to invest for survivability, or to petition for a reexamination of requirements if the cost for full compliance is prohibitive.

[redacted] Where the requirements for survivability are not quantified, but collateral damage invulnerability is required (categories b. and c. above) for the overall DCS, the system designer also has a clear basis for the survivability design. Reference 1 has the most recent and most complete requirements statements of this category. Summarizing quotes from this document are as follows:

[redacted] . . . . "the broad class of DCS (and other general purpose telecommunications) facilities should not be designed to survive a direct nuclear attack on them, they should be designed, to the extent possible, such that they would survive the nuclear effects incident to a nuclear attack on other target systems.

[redacted] "DCA should identify resources necessary to conduct an appropriate DCA/DNA EMP test program and to take those actions necessary to improve the survivability of the DCS against collateral damage."

[redacted] This set of requirements provides guidance to the system designer of the broad class of DCS "both with respect to what he should design

[redacted]

TABLE I. SOURCE AND APPLICABILITY OF CATEGORIES OF SURVIVABILITY REQUIREMENTS (U)

Document Containing Survivability Requirement	DCA System Applicability	Design DCS to be Invulnerable to Collateral Physical Damage	Design DCS to be Invulnerable to Collateral EMP Damage	Provide a Quantified Invulnerability to Direct Attack	Provide Survivability Commensurate with Survivability of Command Served	Survivability Required for Direct Attack but not Quantified
DoD 5105.19 18 Sept 67	All of DCS					X
SecDef Memo 28 Mar 69	All of DCS	X	X			
	Commo for Critical C2					X
SecDef Memo 14 May 70	Commo for NCA					X
JCS 2459/483-8 16 Nov 70	Commo for NCA and SIOP Forces				X	X
DoD 5100.30 2 Dec 71	Commo for NMCS					X
MEECN Master Plan FY 75-84 Jan 73	Commo for NCA and SIOP Forces			X		X ECM Sabotage
DPPG for FY 75-79/ ASD(T) Memo 3 Apr 73	Commo for NCA					X
	Commo for Critical C2	X	X		X	
ASD(T) Memo JCS 2458/857 3 Apr 73	Commo for ANMCC			X		
	Broad Class of DCS	X	X			
	Sat Control Facility					X
	Sat AJ					X
	European DCS					X
JRDoD FY 75-93	Commo for NCA/WWMCCS, All of DCS					X
JSOP (EW) FY 76-83	Military Commo					X
JSOP (C&E) FY 76-83 18 Jan 74	Defense Commo Systems	X	X		X	

TABLE I. SOURCE AND APPLICABILITY OF CATEGORIES OF SURVIVABILITY REQUIREMENTS (CONT.) (U)

Document Containing Survivability Requirement	DCA System Applicability	Design DCS to be Invulnerable to Collateral Physical Damage	Design DCS to be Invulnerable to Collateral EMP Damage	Provide a Quantified Invulnerability to Direct Attack	Provide Survivability Commensurate with Survivability of Command Served	Survivability Required for Direct Attack but not Quantified
JSOP (C^2) FY 76-83 29 Jan 74	Commo for C^2	X	X		X	X
JCSP (Flimsy) C&E FY 74-75 5 Jan 74	Commo for C^2 MEECN				X	X
McGeorge Bundy Memo 21 Aug 63	For NCS					X
Cinceur Msg 131523Z Sep 73	European DCS	X	X			X
DCA Circular 300-90-1 Jan 70	All of DCS	X	X			
DCA Circular 300-90-2 16 Jul 73	All of DCS	X				

for and also what he should not design for (i.e., he should design for collateral damage invulnerability and he should not design to survive a direct attack against communications). It is not stated how much money should be invested to render the DCS invulnerable to collateral damage. The requirement of Reference 1 is to carry this objective "to the extent possible." Obviously, the system designer must evaluate alternatives of design which provide a range of collateral damage invulnerability levels so that management will have a basis for selecting the degree of invulnerability. With respect to this consideration, AT&T has stated that for the past decade approximately 5% of the cost for new transmission routes went for improved degree of invulnerability to collateral damage. The alternatives of DCS design developed by the system designer should cover at least this range (5%) of added cost for collateral damage invulnerability.

[redacted] While the guidance in Reference 1 states that facilities of the broad class of DCS "should not be designed to survive a direct nuclear attack on them," it is a good system engineering practice to select from among equal cost alternatives the design which maximizes the enemy's cost (number of points to be attacked) for a given degree of network destruction.

(U) The last two categories of survivability requirements (d. and e.) provide nonspecific guidance to the system designer, but are useful as a checkpoint in evaluating results of survivability studies. General compliance with these two sets of requirements is verified if for any given scenario the communications system is consistently found to be more survivable than the communications communities served.

(U) The network parameters that are important for invulnerability to collateral damage are:

a. Physical siting of switches to avoid potential target areas.

b. Design of equipments, facilities, circuits, networks, routing schemes, net control systems, synchronizing systems, CRYPTO keyset systems, etc., for operation in a HEMP environment, particularly with relation to service for ciritcally important functions for critical users in stress situations.

c. Design of the network to maintain service to critical users for the case where a chance loss or malfunction in one part of the network is encountered. By definition, a collateral-damage-free facility should not be vulnerable to damage from weapons directed against other targets. However, weapons can go astray or preventive measures (as for rendering a facility invulnerable to HEMP) can be nulified by poor

maintenance, which reintroduces the collateral damage vulnerability. Hopefully, these chance situations should not occur at a large number of places at one time, reducing the designer's problem in designing for them.

d. Use of collateral-damage-free transmission systems for access lines and trunking.

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